



# Glycemic Control in Diabetic Patients With Impaired Endogenous Insulin Secretory Capacity Is Vulnerable After a Natural Disaster: Study of Great East Japan Earthquake

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In March 2011, the Tohoku district of Japan experienced the Great East Japan Earthquake. When treating numerous diabetic outpatients affected by this earthquake, we noticed that post-disaster glycemic control alterations varied among patients. Therefore, we speculated that predicting which diabetic patients have glycemic control that is vulnerable to an extreme situation such as a huge natural disaster is important for allocating limited medical resources effectively in times of great need. Furthermore, predicting who these patients are may enable us to provide them with guidance for postdisaster management in advance, thereby minimizing exacerbation of the diabetic condition. However, at present, there are no available markers predicting post-disaster diabetic vulnerability. Therefore, to identify potentially useful markers, we collected data on several metabolic parameters from 497 diabetic patients who had been followed up at hospitals located in the devastated areas prospectively at 1 and 3 months after the earthquake, and retrospectively using medical records from pre-earthquake time points.

First, we divided the 497 diabetic outpatients into two groups (i.e., the

improved and worsened glycemic control groups) based on HbA<sub>1c</sub> changes, and compared all examined parameters, including gender; age; body weights; ratios of subjects receiving medications for diabetes; and levels of HbA<sub>1c</sub>, serum lipids, and hormones, between the two groups. Among these parameters, notably, fasting C-peptide levels were significantly lower in the worsened glycemic control group than in the improved group at both 1 and 3 months after the earthquake. Moreover, multiple logistic regression analysis after adjusting for factors including gender, age, pre-earthquake HbA<sub>1c</sub> level, and pre-earthquake body weight revealed fasting C-peptide levels to be significantly associated with post-earthquake worsening of glycemic control ( $P = 0.02$ ).

Based on these results, we classified 130 subjects whose fasting serum C-peptide levels 1 month after the earthquake were available into groups with high (fasting serum C-peptide level  $\geq 1.0$  ng/mL), intermediate (fasting serum C-peptide level  $\geq 0.2$  and  $< 1.0$  ng/mL), and low (fasting serum C-peptide level  $< 0.2$  ng/mL) C-peptide levels, according to a previous study (1). Mean fasting serum C-peptide levels of the

C-peptide groups with high, intermediate, and low levels were  $2.46 \pm 1.37$ ,  $0.69 \pm 0.24$ , and  $0.08 \pm 0.04$  ng/mL, respectively. ANCOVA revealed that, after the earthquake, the group with low levels of C-peptide showed greater deterioration of glycemic control than the group with high levels ( $P < 0.05$  after Bonferroni correction) (Fig. 1A). Furthermore, trend analysis showed a clear correlation between lower fasting serum C-peptide levels and worsening of glycemic control ( $P$  for trend  $< 0.05$ ) (Fig. 1A). Importantly, similar trends in changes in HbA<sub>1c</sub> levels were observed in the subjects without interruption of their medication regimens ( $P$  for trend  $< 0.05$ ) (Fig. 1B). Because fasting serum C-peptide level is reportedly associated with endogenous insulin secretory capacity (1–4), these findings strongly suggest post-disaster glycemic control to be particularly vulnerable to deterioration in diabetic patients with lower insulin secretion capacity.

Thus, fasting serum C-peptide levels are the first potential biological marker allowing highly disaster-vulnerable diabetic patients to be identified before a disaster occurs. Therefore, we recommend that physicians measure serum C-peptide levels under normal conditions and provide potentially disaster-vulnerable

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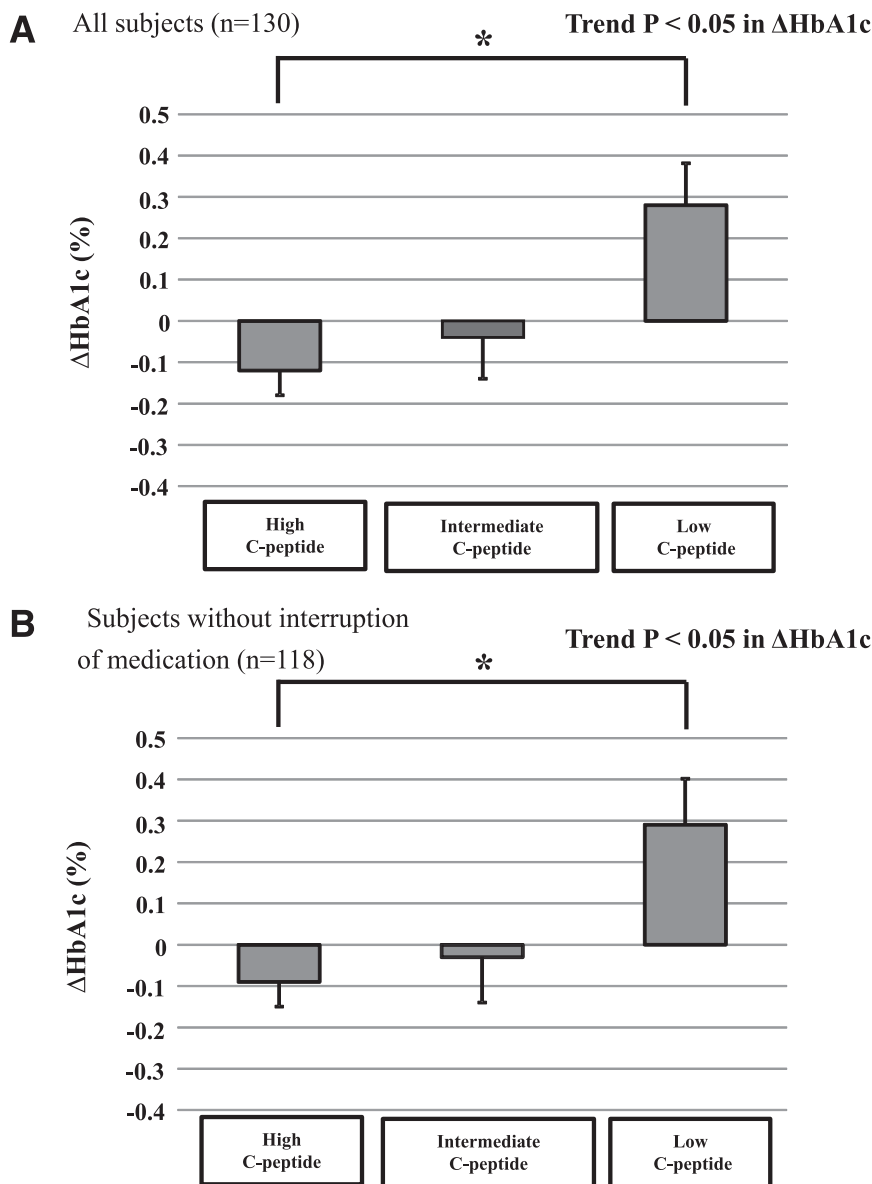
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**Figure 1**—Postearthquake alterations in glycemic control in the groups with high, intermediate, and low C-peptide levels. Postearthquake alterations in glycemic control compared with pre-earthquake levels corrected after adjustment for factors including pre-earthquake body weight, gender, and age were compared among the groups with high, intermediate, and low C-peptide levels by ANCOVA. Trend analysis was also performed for comparisons among the three groups. ΔHbA<sub>1c</sub>, the amount of change in HbA<sub>1c</sub> level at 1 month after the earthquake vs. before the earthquake. *A*: All subjects (*n* = 130). *B*: Subjects without medication interruption (*n* = 118). \**P* < 0.05 between high C-peptide and low C-peptide after Bonferroni correction.

patients with effective information regarding postdisaster management in advance.

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